ABSTRACT

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MARS Orbiter Sample Return Power Design

N. Mardesich, S. Dawson

Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California

The NASA/JPL 2003/2005 Mars Sample Return (MSR) Missions will each have a sample return canister that will be filled with samples cored from the surface of MARS. These spherical canisters will be 14.8 cm in diameter and must be powered only by solar cells on the surface and must communicate using RF transmission with the recovery vehicle that will be coming in 2006 or 2009 to retrieve the canister. This paper considers the aspect and conclusion that went into the design of the power system that achieves the maximum power with the minimum risk. The power output for the spherical orbiting canister was modeled and plotted in various views of the orbit by the SOAP program developed by JPL.

The requirements and geometry for a solar array on a sphere are unique and place special constraints on the design. These requirements include 1) accommodating a lid for sample loading into the canister, surface area was restricted from use on the Northern pole of the spherical canister. 2) minimal cell surface coverage (maximum cell efficiency), less than 40%, for recovery vehicle to locate the canister by optical techniques. 3) a RF transmission during 50% of MARS orbit time on any spin axis, which requires optimum circuit placement of the solar cell onto the spherical canister.

The best configuration would have been a 4.5 volt round cell, but in the real world we compromised with six triangular silicon cells connected in series to form a hexagon. These hexagon circuits would be mounted onto a flat facet cut into the spherical canister. The surface flats are required in order to maximize power, the surface of the cells connected in series must be at the same angle relative to the sun. The flat facets intersect each other to allow twelve circuits evenly spaced just North and twelve circuits South of the equator of the spherical canister. Connecting these circuits in parallel allows sufficient power to operate the transmitter at minimum solar exposure, Northern pole of the canister facing the sun. Additional power, as much as 20%, is also generated by the circuits facing MARS due to albedo of MARS.